THE REDWALL LIMESTONE (MISSISSIPPIAN) OF NORTH CENTRAL ARIZONA

BY

RAYMOND CHARLES GUTSCHICK

B.S., University of Illinois, 1938

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AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN GEOLOGY IN THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS, 1942

URBANA, ILLINONS

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This study establishes a lithologic and faunal basis for the subdivision of the Redwall limestone into its component parts by application of detail stratigraphic methods. The classification is based upon the standard time equivalents of the Mississippian period and can be extended to adjacent regions.

Outcrops of the Redwall limestone are confined to northern Arizona along the southwest margin of the Colorado Plateau. The type section is in Redwall Canyon in the Shinumo drainage basin of the Grand Canyon. The area considered in this study is about 100 miles south of the Grand Canyon in the Black Mesa-Sycamore Canyon-Jerome region.

The formation is very well exposed attaining a maximum thickness of 275 feet. Eleven sections were measured and described and from these and other localities rock samples and fossils were collected. Five lithologic units have been recognized in the Redwall limestone of this region and have each been given member rank. These are arbitrarily numbered in ascending order.

MEMBER 1—The twofold division of this unit reflects the deposition of reworked material on the Devonian erosion surface followed by organized sedimentation of the upper part. The lower beds consist of pockets of purple-red, fine, sandy shale overlain by greenish-gray, thin-bedded limestone with an occasional layer of pink siltstone containing well rounded grains of calcite which weather in relief. These lower beds are also brecciated and maintain a characteristic Devonian lithology. The upper part is white to light-gray limestone, fine-grained grading upwards into coarsely-crystalline texture. Oolites are abundant throughout. The thickness varies from 18 to 45 feet depending upon the presence or absence of the lower reworked beds. The fossil forms which are few and poorly preserved include *Buxtonia* aff. B. *viminalis, Ptychospira sexiplicata, Straparolus obtusus,* and *Paraparchites carbonarius.*

MEMBER 2—Beds consist of light-gray to pink, fine-grained porous limestone which is very thick-bedded and massive. Porosity is due to solution of innumerable tiny fragments of crinoid stems. Isolated nodules and stringers of chert occur in the upper part of the unit. The upper boundary is placed at the top of the irregular, hackly, rust-colored layer of chert. There is appreciable thinning from the Black Mesa to Jerome where it decreases from 52 feet to about 30-35 feet. Fossils are scarce and poorly preserved.

MEMBER 3—This unit has the same lithologic characteristics as Member 2 except for the inclusions of nodular, chert layers. Persistent chert bands alternate with massive limestone every 2 to 3 feet. Variation in thickness is similar to that of Member 2. It thins southeastward from 54 feet at Black Mesa to about 35 feet at Jerome. Practically all the fossils have been obtained from the chert. *Platycrinus absentivus, Hustedia circularis, Leptaena analoga, Productina sampsoni, Spirifer mundulus, S. vernonensis,* and *Spiriferella* (?) *schucherti* are among the more notable.

MEMBER 4—This member is characterized by its unusually uniform composition, texture, and massive expression. It is coarsely-crystalline, crinoidal, granular, white to light-gray limestone which is very thick-bedded. There is a thin zone of red, sandy clastics in about the center of the unit (solution fill). The fauna is prolific. Such forms as *Homalophyllum, calceolum, Syringopora, Pentremites, Buxtonia viminalis Pseudosyrinx missouriensis, Spirifer biplicatus, S. biplicoides, S. centronatus, S.forbesi, S. gregeri, S. grimesi, S. insculptus, S. rowleyi, S. striatiformis, Syringothyris textus, Phillipsia* (?) *peroccidens, Drepanacanthus reversus,* and *Psammodus* are among the more abundant characteristic types.

MEMBER 5—This member consists of a lower thick zone of solution breccia and an upper unit of fine-grained, micro-oolitic limestone. The breccia is composed of chunky, subangular, heterogeneous blocks of limestone which are chinked together with red to maroon, fine-grained sand. The limestone is yellow-

gray, fine-grained and has a resinous luster on fresh fracture. This widespread solution breccia is an easily recognizable unit. The upper limestone is very thick-bedded and weathers into light-gray slopes. The breccia varies in thickness from a few feet to a maximum of 15 feet. The upper member also varies in thickness but this is due mainly to post-Redwall erosion. The fauna is diversified but poorly preserved and includes *Endothyra baileyi, Caninophyllum, Nucleospira obesa, Conocardium pulchellum, Cypricardinia sulcifera, Myalina sp., Straparolus ophirensis, Paraparchites carbonarius,* and *Psammodus plenus.*

On the basis of stratigraphic relations and faunal associations, Members 1, 2, and 3 have been tentatively included in the Kinderhook series. It is questionable what part of Kinderhook time is represented; furthermore, the possibility that Member 3 may be of earliest Osage age must not be overlooked. These have been correlated with the Dawn and Anchor limestone members of the Monte Cristo limestone of southeastern Nevada, the Caballero formation of New Mexico, and the Woodhurst member of the Lodgepole formation of the Madison group. This latter occurs in the northern part of the Cordilleran region of the United States. Member 3 has affinities with the Chouteau formation of the Ozarks. Member 4 is considered to represent early Osage time. This corresponds to Fern Glen, Sedalia, and St. Joe time and may even extend into early Burlington. Correlations are made with the Bullion dolomite member and possibly the Arrowhead member of the Monte Cristo limestone, the Alamogordo member and possibly the Arcente member of the Lake Valley formation, and part of the Mission Canyon formation of the Madison group. Member 5 has been assigned to the Burlington although it may not be as young as late Burlington, it certainly is older than Keokuk. It is correlated with the Yellowpine member of the Monte Cristo limestone, the Dona Ana member and possibly part of the Arcente member of the Lake Valley formation, and part of the Mission Canyon formation.

Character of the sediments and the marine fossils associated with these sediments suggest that the Redwall limestone was

deposited in relatively shallow, temperate marine waters adjacent to lands which had already been reduced close to sea-level.

Sections in the Grand Canyon and southeast Nevada exhibit the same kind of lithology and subdivisions. The faunal elements of the Redwall in northern Arizona indicate that there is much in common with the Escabrosa of southern Arizona. Undoubtedly the two are equivalent, at least in part. Evidence is not sufficient to confirm the presence of Stoyanow's Mazatzal land during early Mississippian time.

VITA

Raymond Charles Gutschick was born in Chicago, Illinois, October 3, 1913. After graduating from J. Sterling Morton High School, Cicero, in 1930, he attended Morton Junior College for two years. In 1936 his education was resumed at the University of Illinois where he received a B.S. degree in Engineering Physics in 1938 and a M.S. degree in Geology in 1939. From September, 1939, to June, 1942, he served as graduate teaching assistant. Part of the summer of 1940 was spent in doing field work in New Mexico, and the entire summer of 1941 was occupied by field work in northern Arizona.

He is a member of Sigma Xi, American Paleontological Society, Illinois Academy of Science, and an associate member of the American Association of Petroleum Geologists and the Museum of Northern Arizona.

He is author of "Niagaran Ostracods from Burlington, Wisconsin," Trans. Ill. Acad. Sci., Vol. 34, No. 2, pp. 164-165, Dec., 1941.

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